

REMARKS

Favorable reconsideration of this application in light of the following discussion is respectfully requested.

Claims 1, 4, 7, 9, 16, 23, 27 and 29-37 are pending in the present application. No claims are canceled, amended, or added by the present amendment.

In the outstanding Office Action, Claims 1, 9, and 27 were rejected under 35 U.S.C. § 102(b) as anticipated by Wan et al. (herein "Wan"); and Claims 29-37 were rejected under 35 U.S.C. § 103(a) as unpatentable over Wan and in view of Bradski.

First, applicants respectfully traverse the rejection of Claims 1, 9, and 27 under 35 U.S.C. § 102(b) as anticipated by Wan.

Claim 1 is directed to an image recognition method that includes obtaining a deformed image by three-dimensionally deforming a captured range image having three-dimensional information including depth information of an object to be sensed, and recognizing three-dimensional motion of an object in the range image by comparing the obtained three-dimensionally deformed image with a newly captured range image. Independent Claims 9 and 27 include similar features.

In a non-limiting example, Figure 12A shows a three-dimensional range image of a hand used in an image recognition method. The range image is deformed, as shown in Figures 9D and 10A, to achieve a deformed image, for example as shown in Figures 12B and 13A. Three-dimensional motion of the hand in the image is recognized by comparing the deformed image with a newly captured range image, for example as shown in Figure 13B.

Applicants respectfully submit that Wan does not teach or suggest a range image having three-dimensional information including depth information, does not teach or suggest a three-dimensional deformation of a range image, and does not teach or suggest a three-dimensional motion is recognized by comparison to a range image. Further, applicants

respectfully traverse the statement in the outstanding Office Action that Wan discloses obtaining a deformed image by three-dimensionally deforming a captured range image having three-dimensional information including depth information of an object to be sensed. Applicants respectfully submit that Wan only discloses receiving 2-D image frames. In particular, Wan indicates that “[t]he system receives a sequence of 2-D image frames.”<sup>1</sup> Further, as shown in Figure 1, Wan indicates that the sequence input to the system is a sequence of 2-D image frames. Thus, 3-D image information is not included in the image frame.

In view of the descriptions and FIG. 1, the system of Wan is divided into three stages: 1) the rough motion detection stage, 2) the moving object extraction stage, and 3) the object identification and the 3-D motion detection stage.

First, applicants submit that Wan does not teach the claimed features in the rough motion detection stage, which includes two types of processes with respect to the input: a correlation network process and a rough motion detection network process. As stated above, the input to these processes is a sequence of 2-D image frames. The process executed in the correlation network is defined by algebraic expressions (1) and (2) in section 2.1 on page 2014. In this way, in the correlation network, the correlations of 2-D images are compared, thus Wan does not perform “three dimensionally deforming a captured range image,” as in the independent claims.

The process executed in the rough motion detection network is defined by the descriptions and algebraic expressions (3) and (4) in section 2.2 on page 2014. This process is an operation including (x, y, t) as arguments, which is a factor of two dimensions and time, thus this process is similarly a two-dimensional process. Furthermore, in FIGS. 1 and 5, Wan shows that this process extracts motion information from a 2-D image, which shows that

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<sup>1</sup> Wan at page 2013, line 14 of section 1.

image deformation is not executed. Hence, applicants respectfully submit that Wan's rough motion stage does not include "three-dimensionally deforming a captured range image having three-dimensional information," as in the independent claims noted above.

Second, Wan does not disclose the claimed features in the moving object extraction stage, which also includes two types of processes with respect to the input: an edge enhancement network process and a background remover process. Wan section 3.1 indicates that the edge enhancement process includes detecting edges, and in view of the descriptions and FIGs. 6 and 7, this process is also two-dimensionally executed. Furthermore, the background remover is defined by algebraic expressions (5), (6) and (7) in section 3.2, and is also a two-dimensional process.

Third, Wan section 4 indicates that the object identification and the 3-D motion detection stages include three types of processes: 2-D motion detection, object normalization & 3-D motion detection, and object identification. Wan indicates that 2-D motion detection is two-dimensional process in section 4.1. Further, as discussed above, before starting the object normalization & 3-D motion detection described in section 4.2 of Wan, no image deformation has been executed, and all of the processes are two dimensional.

In addition, object normalization & 3-D motion detection described in section 4.2 also do not include a range image having three-dimensional information including depth information, three-dimensional deformation of a range image, or three-dimensional motion recognition by comparison to a range image.

As discussed above, the input image ("object's image extracted in the boundary" shown in FIG. 1) in the object normalization & 3-D motion detection in section 4.2 is a 2-D image, thus the input image does not include information in the direction of range.

Further, Wan section 4.2 indicates that noises are removed from this input image.<sup>2</sup> This process is defined by algebraic expressions (8) and (9), and is also a 2-D process. Next, Wan discloses that a normalization process is executed.<sup>3</sup> Here, a normalization network used to perform the process includes the following two types of outputs:<sup>4</sup> size-changed neuron  $c$  and normalized image neurons  $n_{xy}$ .

Wan discloses that  $c = S/m$ , where  $m$  is the normalized size of the object, and  $S$  is an original size of the object image.<sup>5</sup> In other words,  $c$  is obtained by dividing one size with another size, and thus is a “size ratio.” That is,  $c$  is not an image or three-dimensional information, but a parameter value which represents a “size ratio.” Therefore,  $c$  is also not an image having three-dimensional information including depth information, as in the independent claims.

Next, Wan indicates that the calculation of  $n_{xy}$  is a two-dimensional scaling of a 2-D image according to algebraic expressions (10) and (11). That is,  $n_{xy}$  is a normalized 2-D image obtained by scaling.

Further, Wan notes that “[t]he 3-D motion parameter  $\Delta_z$  can be obtained by the difference between  $c^t$  and  $c^{t-1}$ .”<sup>6</sup> Here,  $c^t$  represents a “size ratio” value  $c$  of frame  $t$  and  $c^{t-1}$  represents a “size ratio” value of frame  $t-1$ , thus  $\Delta_z$ , which is the difference between them, is the difference of two “size ratios.”

As stated above, since the “size ratio” does not include three-dimensional information,  $\Delta_z$ , which is the difference between size ratios, also does not include three-dimensional information. Since  $n_{xy}$  is not involved in the calculation of  $\Delta_z$ ,  $\Delta_z$  is not obtained from the deformation of an image.

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<sup>2</sup> Wan at page 2015, fourth line from bottom, to page 2016, line 10.

<sup>3</sup> Wan at page 2016, lines 11-27.

<sup>4</sup> Wan at page 2016, lines 13-14.

<sup>5</sup> Wan at page 2016, line 15-18.

<sup>6</sup> Wan at page 2016, section 4.3.

For the reasons discussed above, applicants respectfully conclude that Wan does not teach or suggest a “captured range image having three-dimensional information,” as in the independent claims, but instead discloses only a 2-D image and a 2-D parameter (e.g. a size ratio). Wan also does not teach or suggest “obtaining a deformed image by three-dimensionally deforming a captured range image having three-dimensional information including depth information of an object to be sensed,” as in the independent claims, but instead discloses a 2-D image scaling  $n_{xy}$  that does not include three-dimensional information including depth information. Finally, Wan does not teach or suggest “recognizing three-dimensional motion of an object in the range image by comparing the obtained three-dimensionally deformed image with a newly captured range image,” as in the independent claims, but instead indicates a calculation  $\Delta_z$  based on a “size ratio” executed to determine 3-D motion. Wan’s calculation does not use a three-dimensionally deformed image and does not execute a three-dimensional deformation. Further, Wan also does not execute a comparison to a range image.

Accordingly, it is respectfully submitted that independent Claims 1, 9, and 27, and claims depending therefrom, are allowable.

Claims 29-37 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Wan and in view of Bradski. Applicants also respectfully traverse that rejection.

Claims 29-31 depend on Claim 1, Claims 32-34 depend on Claim 9, and Claims 35-37 depend on Claim 27, and as discussed above, Claims 1, 9, and 27 are believed to be allowable. Further, it is respectfully submitted that Bradski also does not teach or suggest the features of the independent claims. Accordingly, Claims 29-37 are believed to be allowable.

In addition, applicants respectfully traverse the statements in the outstanding Office Action that Bradski teaches determining a 3-D motion of a rotated image, a deformed image contracted by rotation, and a deformed image moved in parallel, and that it would have been

obvious for one of skill in the art to combine the teachings of Wan and Bradski to achieve the claimed invention.<sup>7</sup>

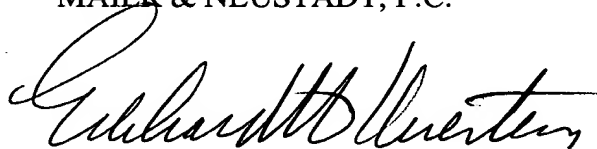
As discussed above, Wan does not disclose an apparatus that recognizes a three-dimensional motion by the comparison of a three-dimensionally deformed image and a captured range image. Furthermore, applicants respectfully submit that Bradski merely discloses an apparatus that extracts a rotation or parallel motion of an image, and thus does not disclose that a deformed image is a rotated image or an image moved in parallel, as in the claimed invention. Accordingly, applicants respectfully request the rejection of Claims 29-37 also be withdrawn.

Consequently, in light of the above discussion and in view of the present amendment, this application is believed to be in condition for allowance and an early and favorable action to that effect is respectfully requested.

Respectfully submitted,

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<sup>7</sup> Office Action at page 5, lines 6-11, at page 5, lines 15-19, and at page 5, line 20, to page 6, line 2.